side view of head of three nestling stages — primaries 4 mm., 13 mm. and 32 mm. long, respectively; 26, *Cocornis agassizi*, dorsal pterylosis.

Plate XIX. ALIMENTARY CANALS.— Fig. 27, *Geospiza conirostris conirostris* (length 205 mm); 28, *G. fuliginosa parvula* (length 170 mm.); 29, *G. fortis dubia* (length 204 mm.); 30, *G. crassirostris* (length 255 mm.); 31, *G. scandens fatigata* (length 200 mm.); 32, *Certhidia olivacea luteola* (length 102 mm.); 33, *Cocornis agassizi* (length 125 mm.).

Plate XX. TONGUES.— Fig. 34, *Geospiza scandens fatigata*; 35, *G. habeli*; 36, *G. fortis fortis*; 37, *G. scandens fatigata*; 38, *G. prosthemelas*; 39, *Cocornis agassizi*, tip of tongue; 40, *Geospiza fuliginosa parvula*; 41, *Certhidia olivacea luteola*; 42, *Cocornis agassizi.*

A CONTRIBUTION TO THE LIFE HISTORY OF THE HERRING GULL (*LARUS ARGENTATUS*) IN THE UNITED STATES.

BY WILLIAM DUTCHER AND WILLIAM L. BAILY.

Plates XXI and XXII.

THE facts presented in this paper are the results of several visits to the large breeding colonies of Herring Gulls on the Maine coast, made at the following dates: by Mr. Dutcher, 1900, from June 28 to July 21; 1901, by both contributors, from June 12 to 24; 1902, by Mr. Baily, from July 18 to 20 inclusive. In 1900 visits were made to nearly all of the colonies along the Maine coast by the senior contributor, commencing at the most westerly one on No-Man's-Land Island, which is situated about seventeen miles south of Rockland, Maine, and adjoins the large island known as Matinicus. In 1901 eight days were spent at the light-house station on Great Duck Island, and subsequently nearly all of the other colonies were revisited by Mr. Dutcher. In 1902 Mr. Baily revisited the Great Duck Island colony later in the season, in order to observe the methods of feeding the young birds and the habits of the young. A description of the position and

topography of Great Duck Island will answer for all of the island colonies, as in the main they greatly resemble each other. Great Duck Island is situated in 44° 9′ N. Lat. and 68° 15′ W. Lon., being an outlying island seven miles south of Mount Desert Island.

The citizens of Maine have reason to be proud of the gull homes in their State, and it is a civic obligation to care for and preserve them. One of the first duties of the patriotic citizen is to carefully conserve the natural objects in his locality; any one who would destroy them, especially for commercial purposes, is lacking in that uplifting sentiment that develops in man or woman a respect for the rights of others, and a love of country and fireside. The writer who commands and wields the most facile pen cannot fully describe the life or beauty of one of the great breeding homes of these gulls, nor can the most accurate photograph convey to the reader more than a faint picture of the bright blue sky, the sparkling sea, the graceful motion of the birds circling overhead; nor can it add the roar of the surf on the rocky shore, nor the weird and angry cries and screams of the anxious gulls. The colony at Great Duck Island is without doubt one of the largest now existing in the United States.

The shore of the island is bold and rocky, and, as the tides rise and fall about thirteen feet, at low water great tracts of kelp rockweed are uncovered, among which the gulls find large quantities of food, such as crustacea and other marine life. At every low tide that occurs during daylight, numbers of gulls may be seen gleaning in the kelp beds, or gathered in groups sunning themselves or preening their feathers.

At high water the upper ledges of rocks are used for assembling and resting places. The surface of the island is somewhat rolling, and in the open is covered with grass and weeds, of not very luxuriant growth, as the soil seems to be very poor, being composed of decayed wood and sand. The trees are principally spruce and fir, but none are of very large size. On the southern end of the island nearly all the trees have been cut and the dead tops and branches, together with many large trunks, have been left among the stumps, making a tangle very difficult to penetrate.

At the extreme southern point of the island the United States

FIG. 1. ROCKY SHORE, GREAT DUCK ISLAND, ME. LOW TIDE.

FIG. 2. HERRING GULLS, GREAT DUCK ISLAND, ME. PROTECTED COLONY.

Lighthouse Department owns a reservation of about two acres. This contains the light tower, three dwellings, engine room, two boat houses, and a long tank-shed for catching rainwater for the fog-whistle engines. The greatest elevation of the island is about sixty feet, the average being about twenty-five feet above high-water mark. The gulls occupy the southern end of the island and are divided into two parts, which may be designated as the east and west colonies. In the former in 1901 there were about twelve hundred birds, and in the latter about eighteen hundred. In 1902 the area of the colony was somewhat larger than the previous year, extending about a hundred yards further northward in the western colony. Probably 3500 birds were breeding, 500 more than last year; on July 15 hundreds of young birds, from a day to three and a half weeks old, were scattered over the two breeding areas.

On our arrival at the island in 1901 nest building and laying was practically completed. One belated gull, however, built and occupied a nest after that date, which afforded us some insight into the method of construction. It was located on a flat rock, as some hundreds of nests were. The rock nests, usually, did not have any stick or twig foundations, but were built of grass, weeds, mosses, lichens, some kelp, either green or dry, feathers, wool, bark, and small bits of drift and rotten wood, all laid upon the rock and formed by the birds into shallow bowls. This special nest was built entirely of fresh green material, and was, when first seen, a flat, scattered mass without any form whatever. It contained one egg, the bird probably having been ready to deposit it before the nest was completed. On several occasions single eggs were found where there were no nests. A few hours later this nest was visited and in the interim the bird had formed it into the usual shape. The nests built upon the ground were almost exactly like the rock nests. Those built on trees or upturned stumps, had a solid foundation of sticks and twigs, and surmounting this the usual form and make of nest. The tree nests are always placed on a flat branch or top of a spruce or fir, one of which was in one about twenty-five feet high; however, they are not common on Duck Island, there being only about a dozen.

The grass in many of the nests was dead and brown, but it is

not certain that it was so when first placed there, although it is probable that the larger portion is old grass. During incubation the weight of the setting bird breaks down or packs the nests, so they are continually being repaired and built up around the edges with new material, which is always green grass or weeds, the effect being very pretty indeed. On several occasions gulls were seen gathering this material in their bills. The grass is bitten off or pulled up by the roots until the bird has a ball in its bill larger than a man's fist. This material is gathered where it is most plentiful and is usually carried by flight to the nest site.

The bowl of the nest varies very little in size, but some foundations are larger than others, depending somewhat upon the location of the nest. The following measurements are of nests selected as good types:

No. 1. Depth of bowl, three inches; from top of nest to ground, ten inches; diameter of nest at top, ten inches, at base, twenty-four inches.

No. 2. Depth of bowl, three inches; from top to ground, five inches; diameter at top, ten inches, at base, eighteen inches.

No. 3. Depth of bowl, two and one quarter inches; diameter at top, nine inches, at base thirteen inches. This nest was built on the ground against a small side hill so that only one side had to be finished.

No. 4. Depth of bowl, two and one half inches; diameter at top, nine inches, at base fifteen inches.

Many other nests were measured and examined, and the average size of the bowl was found to be about ten inches in diameter and three inches in depth.

To obtain a fair average of the size of the eggs, measurements of fourteen sets were made as follows:

No. 1.	Set, 3	$2\frac{10}{16} \times 1\frac{15}{16}$	$2\frac{9}{16} \times 1\frac{14}{16}$	$2\frac{12}{16} \times 1\frac{15}{16}$
2	" 3	$2\frac{15}{16} \times 1\frac{15}{16}$	$2\frac{15}{16} \times 2$	$2\frac{13}{16} \times 1\frac{15}{16}$
3	" 1	$2\frac{15}{16} \times 2$		
4	" 3	$3 \times 1\frac{15}{16}$	$3 \times 1\frac{14}{16}$	$2\frac{15}{16} \times 1\frac{15}{16}$
5	" 3	$2\frac{14}{16} \times 1\frac{15}{16}$	$2\frac{13}{16} \times 1\frac{15}{16}$	$2\frac{12}{16} \times 2$
6	" 3	$2\frac{15}{16} \times 1\frac{14}{16}$	$2\frac{14}{16} \times 1\frac{15}{16}$	$2\frac{13}{16} \times 1\frac{15}{16}$
7	" 3	$2\frac{14}{16} \times 2\frac{1}{16}$	$2\frac{13}{16} \times 2$	$2\frac{13}{16} \times 2$
8	" 3	$3\frac{1}{16} \times 2$	3×2	3×2
9	" 2	$3 \times 1\frac{12}{16}$	$2\frac{15}{16} \times 1\frac{13}{16}$	
10	" 3	$2\frac{14}{16} \times 1\frac{13}{16}$	$2\frac{13}{16} \times 2$	$2\frac{13}{16} \times 1\frac{15}{16}$
11	" 3	$2\frac{8}{16} \times 1\frac{15}{16}$	$2\frac{11}{16} \times 1\frac{15}{16}$	$2\frac{11}{16} \times 1\frac{15}{16}$
12	" 2	$1\frac{14}{16} \times 1\frac{5}{16}$	$2\frac{13}{16} \times 1\frac{13}{16}$	
13	" 3	$3\frac{2}{16} \times 1\frac{15}{16}$	3×2	$2\frac{13}{16} \times 1\frac{15}{16}$
14	" 1	$2\frac{6}{16} \times 1\frac{11}{16}$		

It is remarkable how quickly the eye can detect any variation in the size of an egg, as by it the shape is entirely changed. The abnormal egg in set No. 12 was infertile. Capt. Stanley, head keeper of the lighthouse, was requested to watch the nest, and he reported later that the two eggs completed the set, and that the small egg did not hatch, but the other one did, bringing forth a healthy chick. Only three runt eggs were found among the 3500 or 3600 eggs in the two colonies.

The color of the eggs varied in a remarkable degree. The ground colors were light sky blue, dead blue, light blue-gray, light gray-blue, dark lilac gray, light gray, light pea-green, green drab, warm drab, ochre drab, pink drab, light brown, and cinnamon.

The colors of the markings were chocolate, brown, rich brown, light brown, snuff brown, asphalt, black, lilac, mauve. The shapes of markings were almost infinite,—large and small spots, indistinct specks, blotches, lines and irregular streaks, somewhat like the markings on the eggs of blackbirds. One egg was found with a light sky blue ground color with tiny indistinct specks of lilac and light brown. Some of the markings were so confluent that they resulted in a distinct ring around the egg.

Among the many hundred sets of eggs seen the usual number was three, rarely two, and more infrequently one. Only one set of four was found, which was on Heron Island, in Penobscot Bay; in other respects the set was normal.

Regarding incubation, Capt. Stanley pointed out the nest in which the first eggs were laid in the season of 1901, which were as yet unhatched; they were subsequently watched very closely, being visited a number of times daily. On Tuesday, June 18, in the afternoon, one of the eggs commenced to show signs of hatching; the shell was cracking about one inch from the large end. On Wednesday afternoon the cracked portion had broken open so that a part of the bill of the chick could be seen. The other two eggs had also become pipped or cracked. About 3 P.M. on Thursday the first bird was out of the shell and was not yet dry. It was a very weak and helpless object, so much so that it could not stand for more than a moment, when it would lie down, and even its head would be flat in the nest. On Friday morning, a little after

5 o'clock, we found the second chick, it having come out during the night. The first chick, however, was strong enough on our approach to run from the nest and hide under a nearby stump (Plate XXII). The oldest bird was placed in the nest again and the two photographed with the third egg, which was now so opened that the bill of the chick showed. When the young chicks are hatched the egg shell divides very evenly at the point where the bill of the young appears. The discarded shells are never found in the nest but are carried by the old birds some feet away. About the middle of the afternoon on Friday the third chick was hatched, thus making an interval of about twelve hours between the hatching of each egg. When the third egg had hatched the other two young birds were found hiding under nearby stumps, not to get out of the sun or cold, for it was a warm cloudy day. The instinct to hide seems to be developed within an hour or two after hatching, or so soon as the young bird is strong enough to walk. The young in tree nests also seem to have sense enough not to walk off the edge of the nest, for in 1902 Mr. Baily found young at least ten days old in a tree nest. The young when very small have a weak, peeping note that cannot be heard at any great distance; this seems, however, more a petulant cry for food than of fear or anger, for it is not uttered when the young chicks are handled, nor do they make any outcry then, even up to the time that they are large enough to fly a few feet; however, the young birds can protect themselves by giving very sharp bites with their bills: this seems to be their only method of defence prior to flight, except running and hiding.

The downy plumage of the young when three days old is as follows:

Under parts dusky white, running into gray on flanks and abdomen. A distinct triangle of light cream white on the centre of belly between breast and abdomen. Breast gray, throat and head cream gray with distinct tinges of buff. Back mottled light gray and dusky, getting more buff on head. Wings: scapular space buffy, primary space gray. The gray is also darker on tertial space on wings. On back the down is dark at the base, and grows lighter near the ends. The whole upper part of the bird is covered with dull black spots, irregular in shape. Bill horn black with pink tip, three-sixteenths of an inch long. Feet dusky pink, darker on edges and under portion.

FIG. 1. YOUNG HERRING GULL, SIXTY HOURS OLD, SHOWING RAPIDITY OF GROWTH.

FIG. 2. YOUNG HERRING GULLS AND PIPPED EGGS.

The rapidity of growth of the chicks is very remarkable, and is illustrated in the accompanying photograph (Plate XXII), showing the comparative size of an egg and a chick sixty hours old.

On June 25, 1901, the young were hatching very rapidly; a superficial census was taken of a portion of the east colony, and ten nests with young were found. Capt. Stanley wrote under date of July 26, 1901, that "some of the young birds are flying over the rocks with the help of their legs for a kick now and then." These probably were those first hatched, which would indicate that they begin to fly in from thirty to forty days.

At the time of the 1902 visit hundreds of young were present; these, when approached, even from a great distance, all ran to hiding places under the long grass, logs, or bark, behind rocks, or wherever they could find a place to poke their heads out of sight. They are very easy to find, as some part of the body is generally in view. Sometimes four or five will be found under one fallen log or decayed stump. The parents are on the wing above as long as a person is in evidence, but on the intruder hiding for a short time, they settle down, one at a time, upon their favorite perches, on top of the trees or dead stumps, rocks, etc., and apparently after some vocal communication to their young, the latter begin to back out of their hiding places and strut about, picking at objects on the ground, and now and then chasing after their parents, squeaking for something to eat.

Regarding the food of the young birds but little evidence can be offered, but that is very direct and positive. Young birds on two occasions, when being handled, vomited their stomach contents, which were preserved in separate bottles with alcohol. Five samples of stomach contents were obtained in all, which were sent to the Biological Survey in Washington. Dr. Sylvester D. Judd, of that Department, furnished a report of his examination, which is as follows:

No. 1. *Larus argentatus*, Duck Island, June 22, 1901. Contents: Muscle, bones, scales, and digestive tract of a fish not more than 4 inches long, 100%. Total amount, 100% animal matter.

No. 2. *Larus argentatus*, Duck Island, June 23, 1901. Contents: 5 blow flies (*Calliphora vomitoria*), 25%; 3 moths, one of them a noctuid, 15%; 1 *Anisodactylus* (carabid), 5%; 1 *Leptura* (cerambycid), 5%; remains of a small fish 50%. Total amount, 100% animal matter.

No. 3. *Larus argentatus*, Duck Island, June 25, 1901. Contents; 17 *Calliphora vomitoria*, 40%; 1 weevil, 1%; 1 brown carabid beetle, 2%; 2 *Lachnosterna* (May beetles), 7%; remains of fish, 30%; vegetable rubbish 20%. Total amount, 20% vegetable matter; 80% animal matter.

No. 4. *Larus argentatus*, No-Man's-Land, July 4, 1901. Contents: 2 funnels and a propodium of squids about 4 inches long. Total amount, 100% animal matter.

No. 5. *Larus argentatus*, No-Man's-Land, July 4, 1901. Contents: Eye and epidermis of a very small squid, 25%; prosternal process of elaterid beetle, 20%; tibia of a May beetle, 30%; elytron of a carabid beetle, 25%. Total amount, 100% animal matter.

In 1902 Mr. Bailey observed the parents disgorge food on the ground which the young picked up and swallowed whole. The larger young will often tackle a squid, apparently several times too large for them, and after several unsuccessful attempts will worry it down, when the bird looks as though he were sorry and would like to change his mind. In some instances the parents seemed to exhibit very little judgment as to the ability of their young, and would leave a big, tough squid in the nest for a day old young one to devour. Several such were watched picking and pulling for some time without securing any nourishment. On visiting the nest a half hour later it seemed that the parent had also been convinced that her babies were not equal to the task and had removed the squid.

The mortality among the young varies. In 1900 the island of No-Man's Land was visited at the height of the breeding season when hundreds of young gulls of all sizes could be seen. Only a very few dead ones were found and they were generally those not more than three days old. In 1901 so few young were hatched on Duck Island, at the date the observations were ended, that no data could be obtained; however, No-Man's-Land was visited July 4, 1901, and it was found that from 60 to 70% of the eggs were hatched and that hundreds of young birds were hiding everywhere. A search for dead birds was made but very few were found. In 1902 Capt. Stanley reported that during the season about 200 young birds were killed by the adults, and nearly as many more were killed by sheep stepping on them, and others by being caught under rocks and brush where they go to hide.

In the report of stomach contents, that of No. 5 was taken from

a bird that was found dead. It was examined very carefully for wounds or any evidence of a violent death but none was found, and the conclusion must obtain that it died from some natural cause. The downy plumage of the bird was in such excellent condition that it was preserved, and it was found while skinning it that the body was very much emaciated, which would indicate death by starvation, although a small amount of food still remained in the stomach.

On Duck Island the remains of one young gull was found that had met a violent death; a small portion of the back, one foot, the tarsus and tibia, the stomach and a little of the viscera remained, the rest having been eaten. From the appearance of the remaining portions it was judged that the bird had been killed by a hawk, as it had been pulled apart; it showed no marks whatever of being chewed by a mammal. No hawks were seen on the island, although Capt. Stantley states that members of the hawk family often visit the island, especially during the migratory season.

The Captain also stated that the crows on the island destroyed some eggs, but he had never seen any evidence that they ever ate young gulls. He also stated that he was sure there were no four-footed enemies of the gulls, as he had made diligent search on the island for mammals and could never find the slightest trace of any. He had carefully looked for tracks in the snow many times but always without success. The Captain also says that the old birds sometimes kill the young. The adult seems then to exhibit great anger and strikes the victim with its bill until it is dead. In all probability the one killed is not its own offspring, for it seems impossible that any bird that exhibits the solicitude for its eggs and young that the Herring Gull does could become an infanticide. In 1902 Mr. Baily saw an old bird actually striking the head of a young bird about ten days old, while the helpless little fellow, with quivering wings, implored the old one to stop. But with only occasional pauses he continued the torture, just as a cat does before eating a mouse. Then he would strike his victim in the back pulling out its half-grown feathers. The blows came harder and harder, and when the poor thing collapsed, the old bird walked away a few feet and uttered the worst noise he was

capable of, but returned to finish his work at the sound of a last weak cry. A few minutes later another old bird faced the murderer, and they cursed one another for all they were worth, but no attempt was made to strike. What the relation was between the three parties could not be determined, nor could it be surmised why the real parent, or some neighbor, did not interfere and prevent the tragedy. However uncommon this occurrence, it was not unique, for at least six dead birds were found in various places, all of about the same age, which had been dealt with in a similar manner, their heads, backs and wings being bruised and blood-stained. Nothing deformed or unhealthy about these birds was noted and no solution can be suggested, unless it be that the young birds were lost and were put to death by old birds who objected to being pestered for something to eat by other people's children.

Great opportunities for the study of the habits of the adult gulls were offered on Duck Island and some interesting facts were observed; among these was evidence that both the male and female parents take part in the incubation of the eggs. On one occasion, while photographing gulls on nests, it was noted that the first bird that occupied the nest, after the camera was focussed, had a number of dark feathers on its breast; after it had left the nest a bird with a pure white breast occupied it. That this was a mated pair there is no reason for doubt, for they were together, and both exhibited the greatest solicitude for the nest and its contents. It was also observed that as the period of incubation neared its end the anxiety of the parents increased in a marked degree, so that it was easy to determine the stage of incubation by the actions of the parents. During the last few hours before the pipping or cracking of the egg the parent birds were so fearless that they would leave the nest only on a near approach, and while the camera was being focussed would remain within a few yards, perched either on the ground or a low tree or stump. Exposing the plate was always made with a bulb at a distance of forty to sixty feet, and before it could be reached one of the parent birds was sitting on the nest again. In such a case as this it was not necessary to cover the camera at all; on the other hand, if incubation had not advanced so far, it was neces-

sary to cover the camera in the most skillful manner or else wait for hours before the gull would return to the nest. On sunny days during the hours of greatest heat, say from 12 to 3 P. M., the nesting gulls were not so anxious to remain on the eggs, nor did the eggs cool enough to do them harm.

Mr. Baily, in 1902, built a blind of sticks, old ship trash, etc., about ten feet from a nest containing three eggs. While inside he seemed to be entirely forgotten by the birds, for in less than five minutes a bird alighted on top of the blind, which must have been placed near its favorite perch. In about ten minutes the owner of the nest was noted standing about thirty feet away, suspiciously eyeing the hut, but before long she cautiously but proudly marched to the nest. In her bill was a bunch of dry grass which she deposited on the side of the nest, which was placed in the green grass and clover against a small log. For several hours the nest was watched and on two occasions of the seven when the bird returned to the nest she turned the eggs slightly. They had previously all been marked with an arrow pointing in one direction, and it was found she had only turned one of the pipped eggs. She did not seem at any time to make any examination of the eggs, but turned them with her bill after she had nestled down into position. She always alighted some little distance from the nest, and after looking about to see if the coast was clear, walked rather deliberately to the nest, and carefully, tenderly sank into it, moving her body from side to side about six times, as if to work the feathers between the eggs; she then sat with her head erect, turning it to the right or left every second or two, watching all that was going on about her. Her mate was continually on guard about fifteen feet away, sitting on a fallen log.

A high temperature seemed to have a marked effect on the gulls, for it was noticed that they kept their mandibles open and the tongue raised as if in distress for air. This was observed both with the setting gulls and those that were perched about on the trees and rocks. The calls and cries of the adult were very varied and seemed to fit each occasion. On our entering one of the colonies, all the nearby birds would rise into the air, each one screaming *Kak-kak-kak* at the top of its voice. As the intruder advanced further into the colony the number of